



# Armed Forces College of Medicine

## AFCM



## **Viral Lower Respiratory tract infections (Part 1)**

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## INTENDED LEARNING OBJECTIVES (ILO)



**By the end of this lecture the student will be able to:**

1. Describe the structure and antigenicity of viruses causing LRTIs
2. Describe pathogenesis and clinical manifestations of viral LRTIs
3. Outline laboratory diagnosis of viral LRTIs.

# Respiratory Tract Infections

## Upper respiratory tract Diseases

## Upper and Lower respiratory Tract Diseases

## Lower Respiratory Tract Diseases

### Common Cold Pharyngitis

Otitis Media

Sinusitis

### Laryngitis

Epiglottitis

### Croup

### Influenza

Whooping Cough

### Bronchitis

### Bronchiolitis

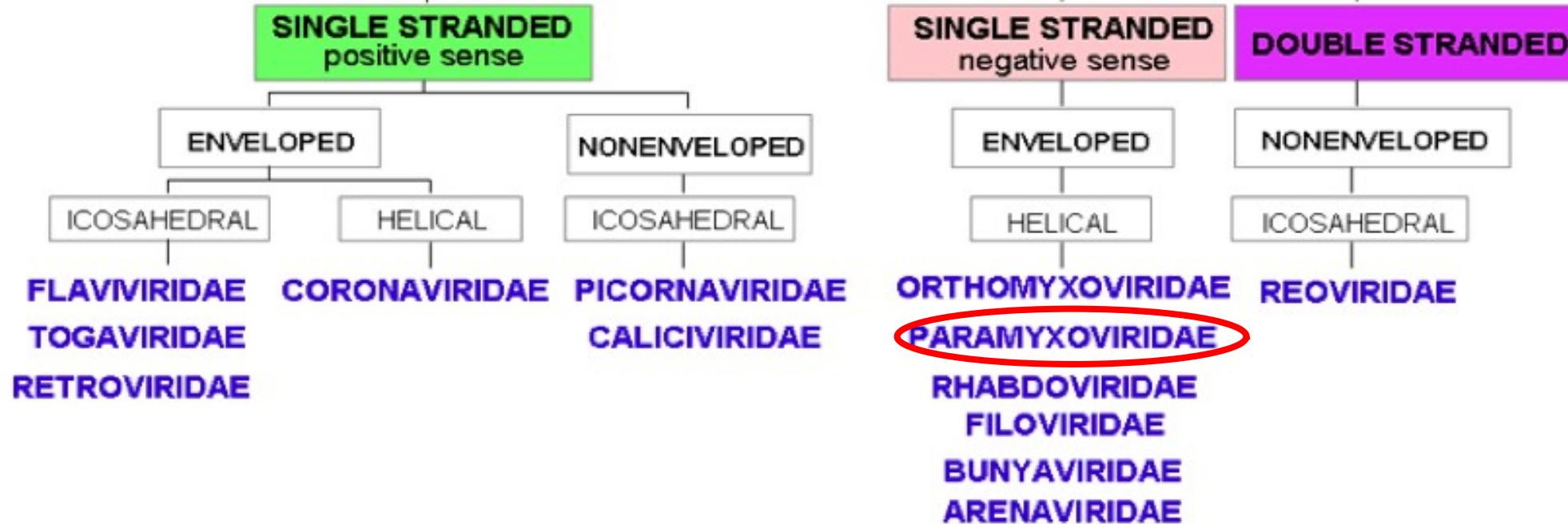
### Pneumonia

Pulmonary TB

Lung Abscess



## RNA VIRUSES



# LARYNGITIS

## 2-Group

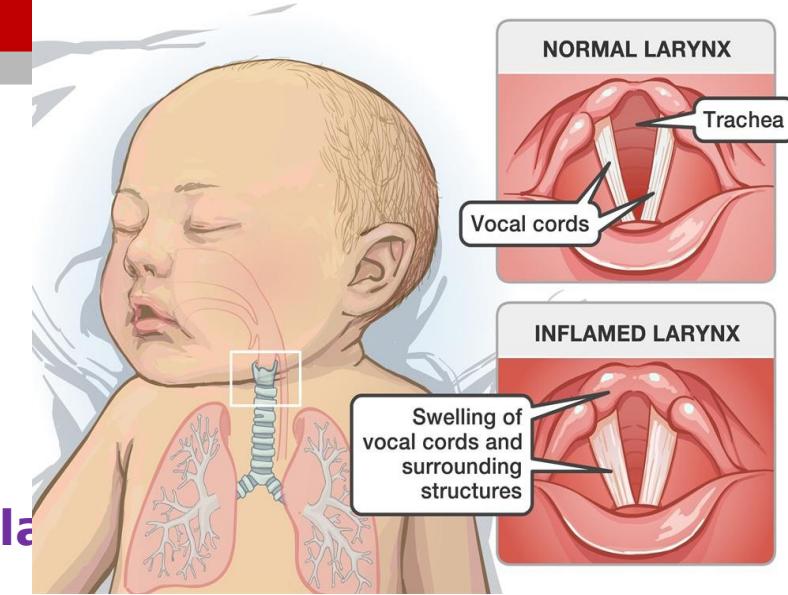


### Definition

Inflammation of vocal cords of the larynx

### Etiology

**1- Parainfluenza virus & Rhinoviruses ( commonest causes of laryngitis)**



2-Influenza & corona viruses

### Clinical picture

#### ■ Hoarseness of voice

#### ■ Aphonia (inability to speak)

9/11/24  
infectious module



# CROUP



## Definition

Inflammation of larynx, trachea & large bronchi (laryngotrach

## Etiology

1- Parainfluenza virus (especially type 1): commonest ca

2- Respiratory syncytial virus (RSV)

## Clinical manifestations

1-Inspiratory stridor (harsh noise on breathing due to obstruc

especially in children

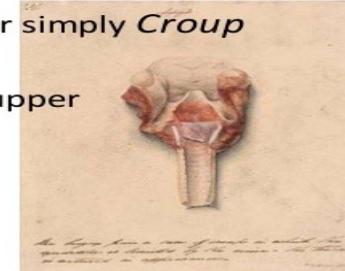
2-Hoarseness of voice

## Croup

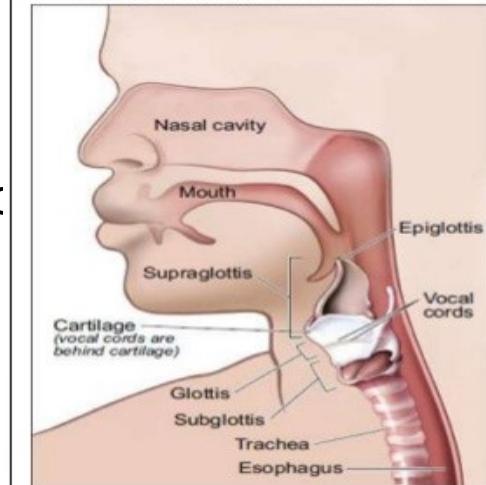
Derived from the old Anglo-Saxon verb croup meaning "to cry hoarsely".

Laryngotracheobronchitis or simply Croup

The most common form of acute upper respiratory obstruction.

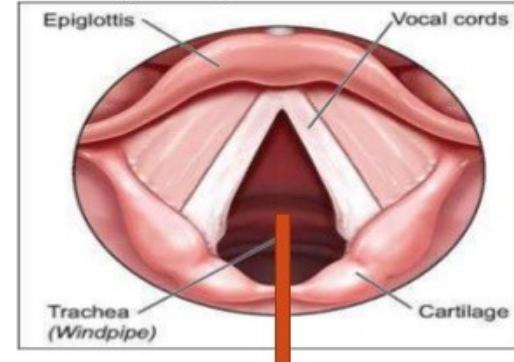


### Mechanism of developing stridor



Stridor can occur at the following places:

1. Nose & Mouth
2. Larynx (Epiglottis, Supraglottis, Glottis, Subglottis)
3. Trachea.



- An infant or child's airway lumen is naturally narrower/smaller than adults.
- Therefore, any minor reductions to this airway diameter (such as inflammation, mucosal edema, foreign object, collapsing epiglottis) can result in further narrowing or obstruction of the airway.
- Due to this narrowing, it causes an exponential increase in airway resistance which makes it significantly difficult for the child to breathe.

# Human parainfluenza viruses (HPIVs)



## Structure

### A - Family : paramyxoviruses

### B-Nucleocapsid

#### ■ ss RNA

- Helical

### C- Enveloped with 2 surface glycoproteins

#### 1-Bifunctional protein : Haemagglutinin-neuraminidase (H)

attaching the virus

to host-cell

releasing new

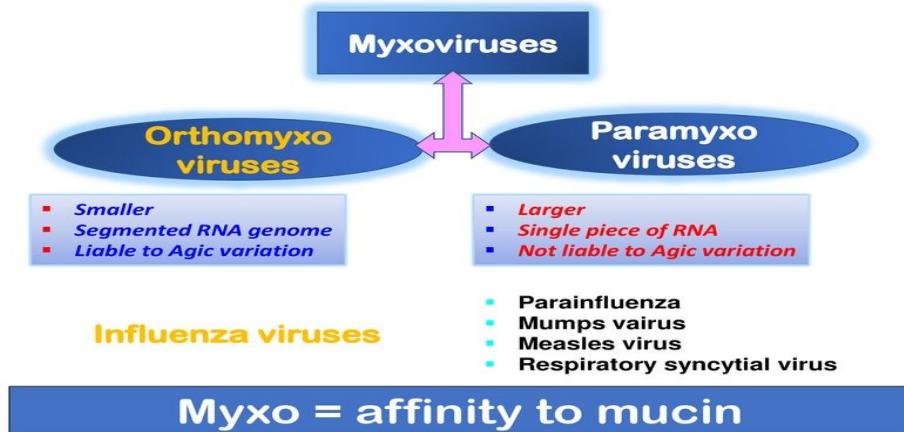
virions from  
infected cells(late).

#### 2-Fusion (F) protein (see RSV)

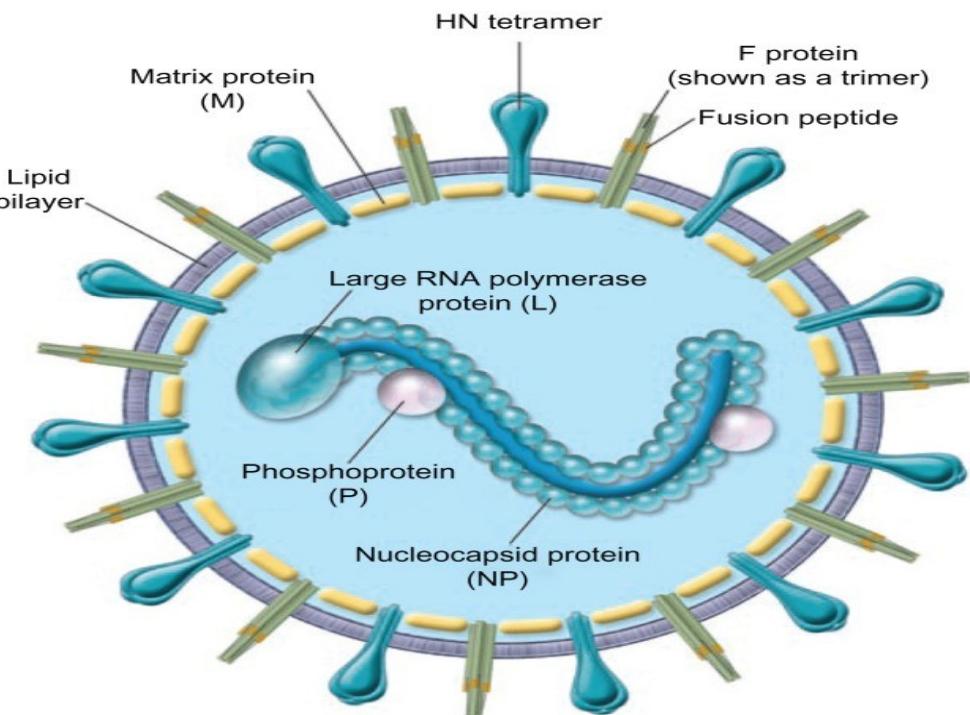
### C-Classification

4 serotypes : HPIV 1, 2, 3, 4

9/11/24



infectious module



# Human parainfluenza viruses (HPIVs)



## Pathogenesis & Clinical manifestations

**A-The infection is localized to RT (no viremia).**

in both adults & young children

The virus attaches to host cells by **haemagglutinin**

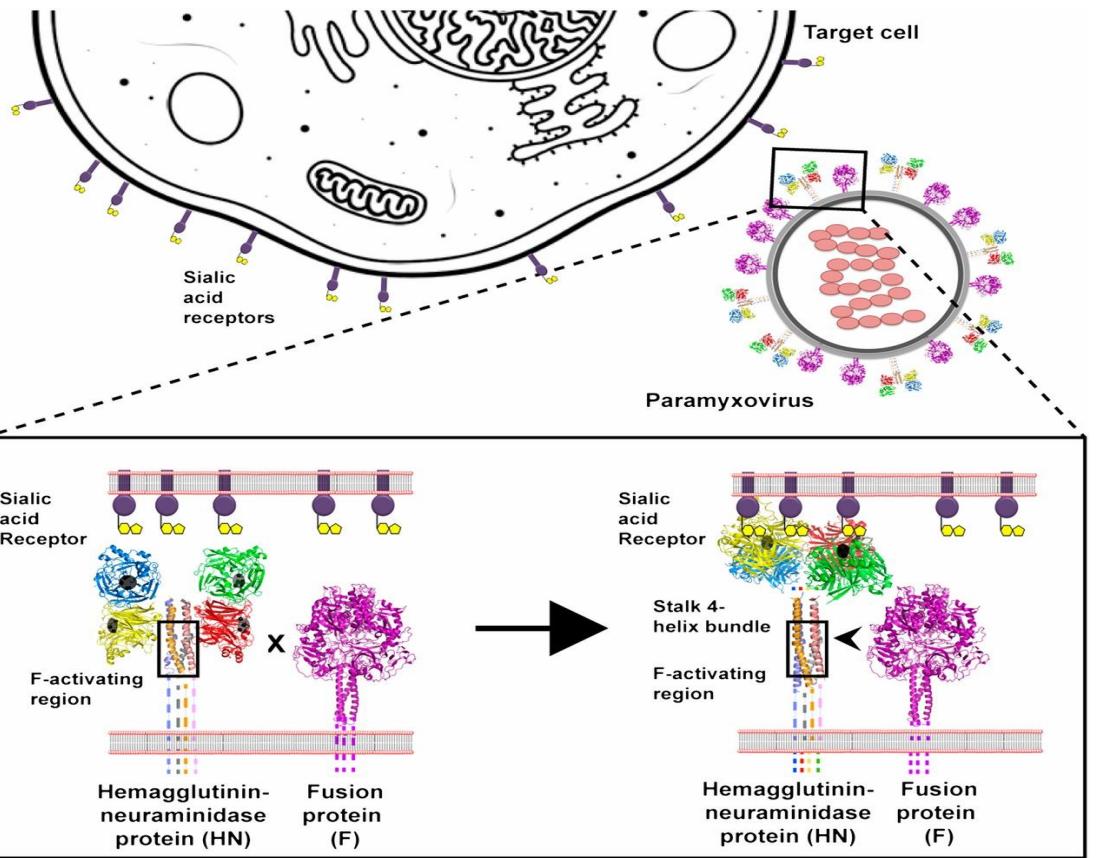


Envelope fuses with the host cell membrane by **F protein**

**B-In adults**

- Virus multiplication & Inflammation **are limited** to **upper RT**

**Disease: Common cold.**



infectious modul



# Human parainfluenza viruses (HPIVs)

## C - In young children < 5 years

- Airways are small & immunity is immature



Bronchi, bronchioles and lungs are involved

- Vocal cords of the larynx become swollen



Obstruction to the inflow of air



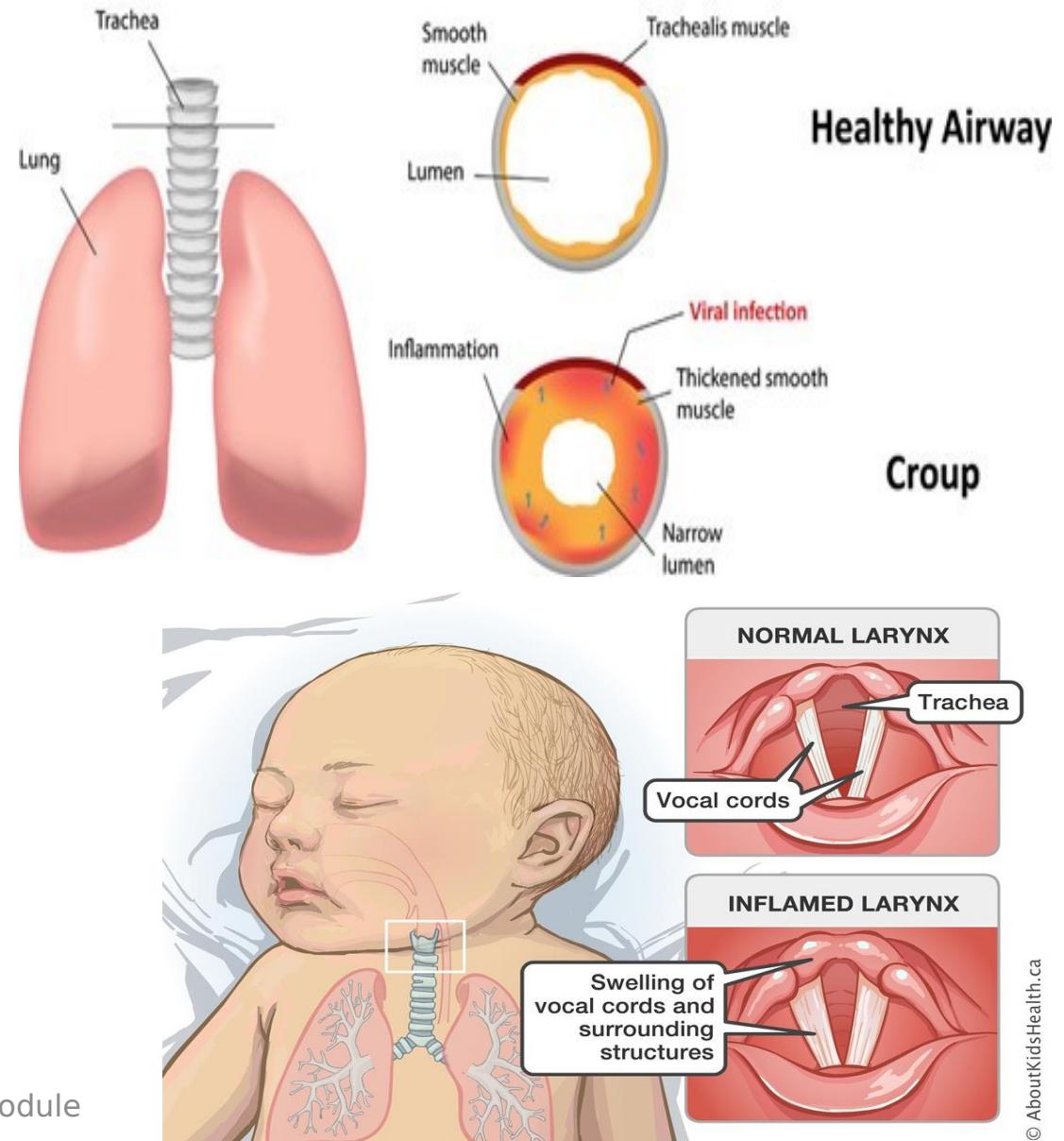
**Inspiratory stridor**

### ■ Diseases

1-Croup (acute laryngotracheobronchitis)

2-Laryngitis, bronchiolitis and pneumonia.

infectious module



# Human parainfluenza viruses (HPIVs)



## Laboratory diagnosis

**Specimen:** nasopharyngeal aspirate.

### A-Direct demonstration

**1-Detection of Ag :** by DIF

**2-Detection of viral RNA :** by PCR

### B-Serology :

Detection of **IgM OR rising titer of IgG**

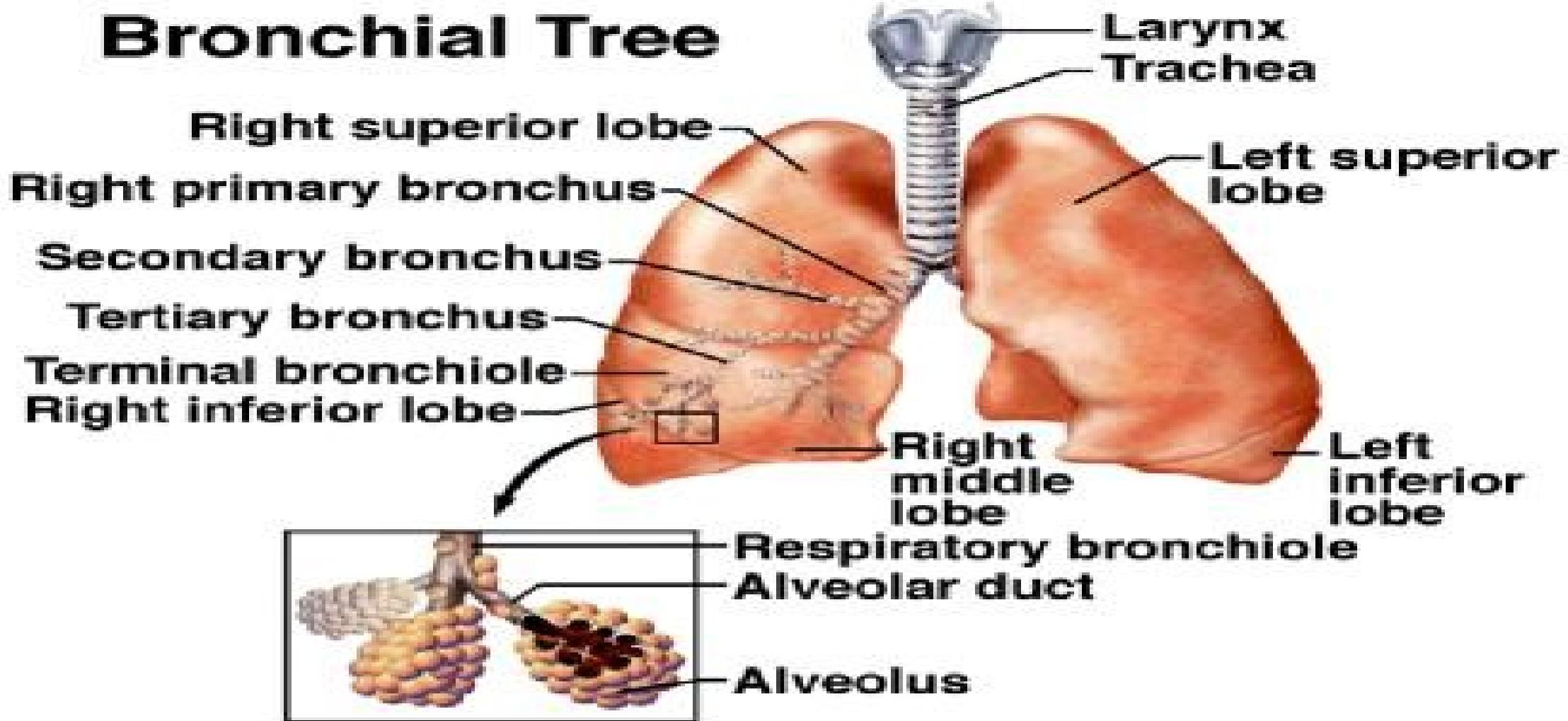
### Parainfluenza Virus Laboratory Diagnosis

- **Detection of Antigen** - a rapid diagnosis can be made by the detection of parainfluenza antigen from nasopharyngeal aspirates and throat washings.
- **Virus Isolation** - virus may be readily isolated from nasopharyngeal aspirates and throat swabs.
- **Serology** - a retrospective diagnosis may be made by the detection of IgM antibodies.

# Lower Respiratory Tract Infections



## Bronchial Tree



# Respiratory Tract Infections

## Upper respiratory tract Diseases

## Upper and Lower respiratory Tract Diseases

## Lower Respiratory Tract Diseases

### Common Cold Pharyngitis

Otitis Media

Sinusitis

### Laryngitis

Epiglottitis

### Croup

### Influenza

Whooping Cough

### Bronchitis

### Bronchiolitis

### Pneumonia

Pulmonary TB

Lung Abscess

# 1-BRONCHITIS

## Definition

**Self limited** inflammation of bronchi

Etiology of acute bronchitis

**Viruses : Most common 1ry pathogens**

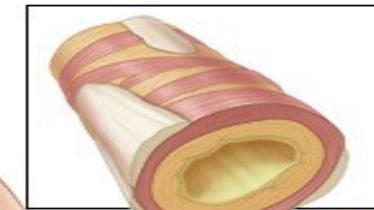
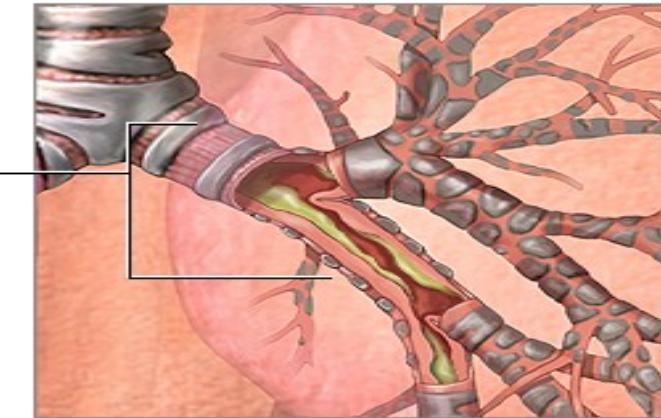
1-Influenza viruses

2-Parainfluenza viruses ,

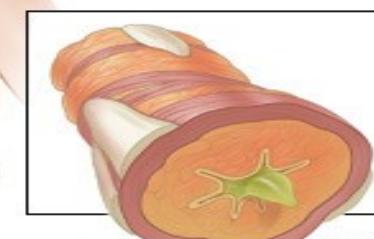
3-Respiratory syncytial virus



Inflamed primary and secondary bronchi



Normal bronchial tube



Inflamed bronchial tube

# 1- BRONCHITIS

## Pathogenesis

★ Viral infection → inflammatory response

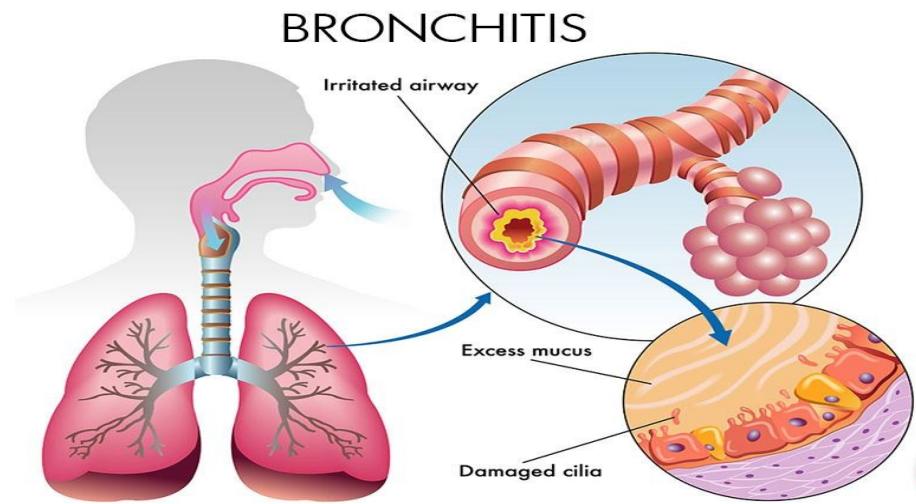
→ ↑ mucus production

→ **coughing** ( to clear mucus).

## ★ Clinical Manifestations

**1- URTIs symptoms** : Nasal congestion, sore th

**2-Cough , with or without sputum**



### The Symptoms of BRONCHITIS



- Cough
- Production of mucus (sputum), which can be clear, white, yellowish-gray or green in color
- Fatigue
- Shortness of breath
- Slight fever and chills
- Chest discomfort

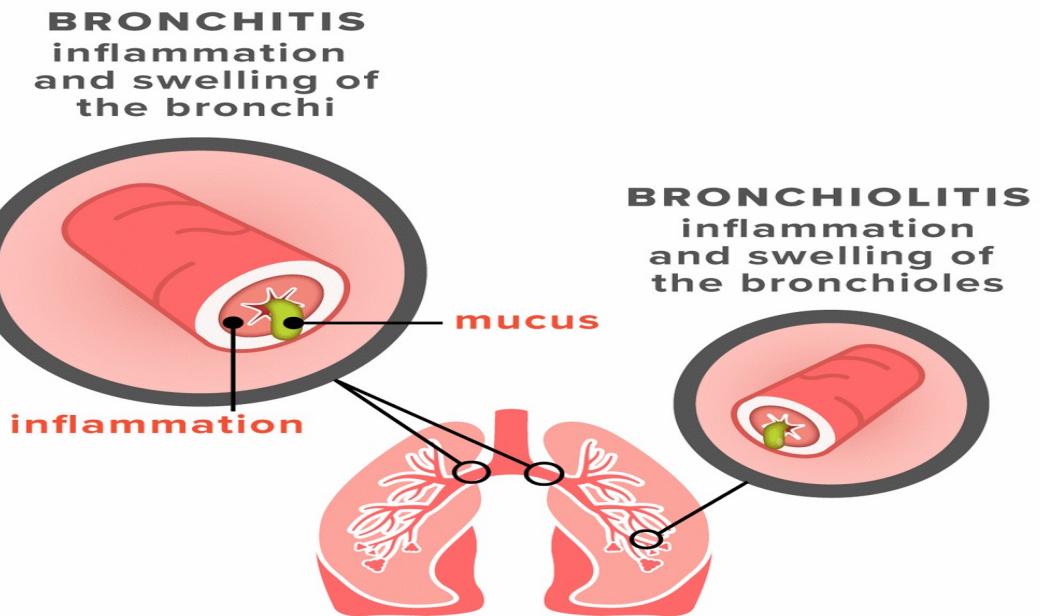
# 2-BRONCHIOLITIS

## Definition

Inflammation of the bronchioles ;  
the small airways **less than 2 mm in diameter**

## Etiology

**Viruses are the only pathogens in children**



**1-Respiratory syncytial virus (main cause)**



**2-Human metapneumovirus (2<sup>nd</sup> common cause)**

Bronchiolitis is caused by a viral infection and is seasonal ,peaking in the winter months.

**3- Parainfluenza virus**

The most common cause is respiratory syncytial virus (RSV) which accounts for 80% of cases

# 2-BRONCHIOLITIS



Pathogenesis

Age affected

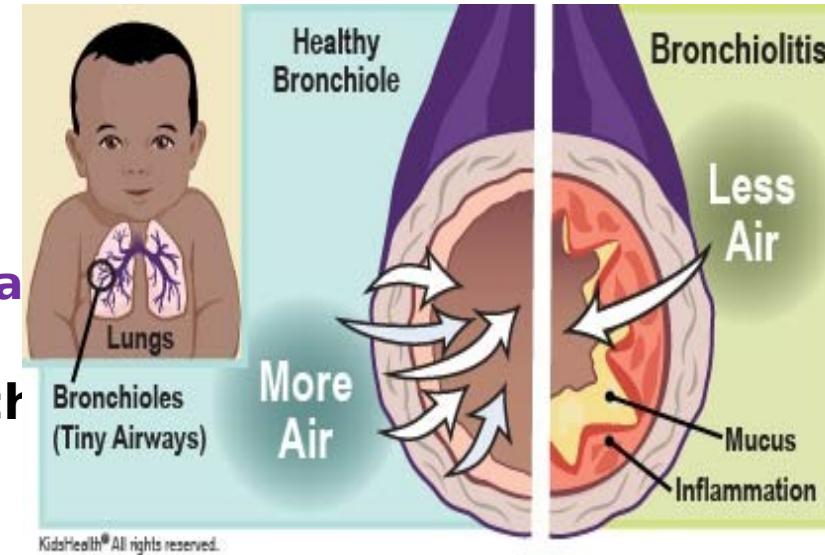
Particularly among children under 2 years of age as bronchioles have



Viruses directly damage the epithelial cells of the terminal bronchioles



Inflammation and obstruction of the small airways.

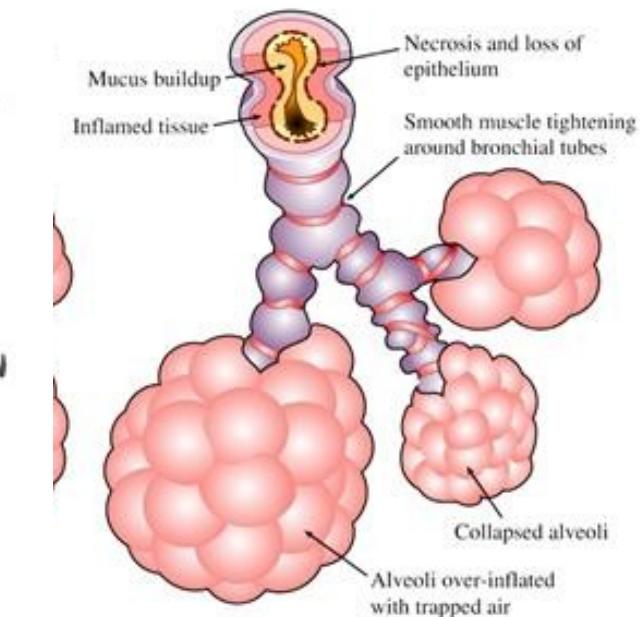


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Clinical Manifestations

Respiratory distress

- Cough, cyanosis
- Dyspnea



# Respiratory syncytial virus (RSV)

## Structure

### A - Family : paramyxoviruses

### B-Nucleocapsid

#### ■ SS RNA

- Helical

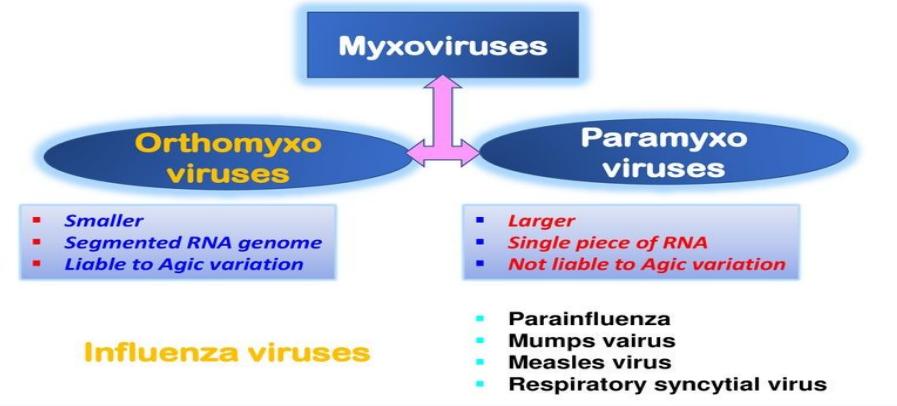
### C- Enveloped ,with 2 surface glycoproteins (No H/N)

#### 1-G protein

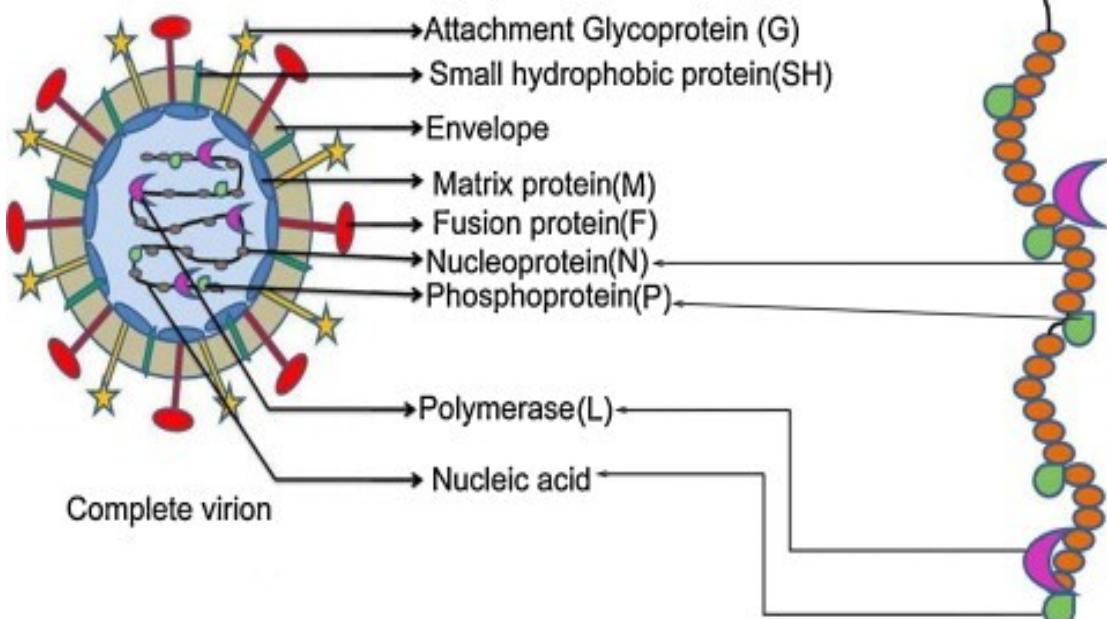


**Attachment** to host cells

#### 2-Fusion (F) protein



**Myxo = affinity to mucin**



# Respiratory syncytial virus (RSV)



## Pathogenesis

### A-Mode of transmission

#### 1-Droplet

#### 2-Direct contact of contaminated hands with nose or mouth

RSV causes outbreaks of respiratory infections especially in children.

### B-Viral replication

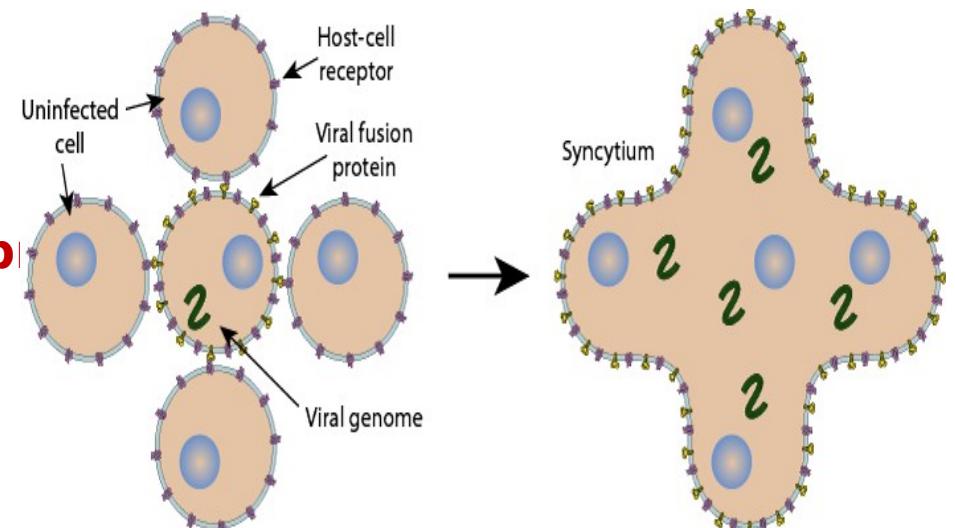
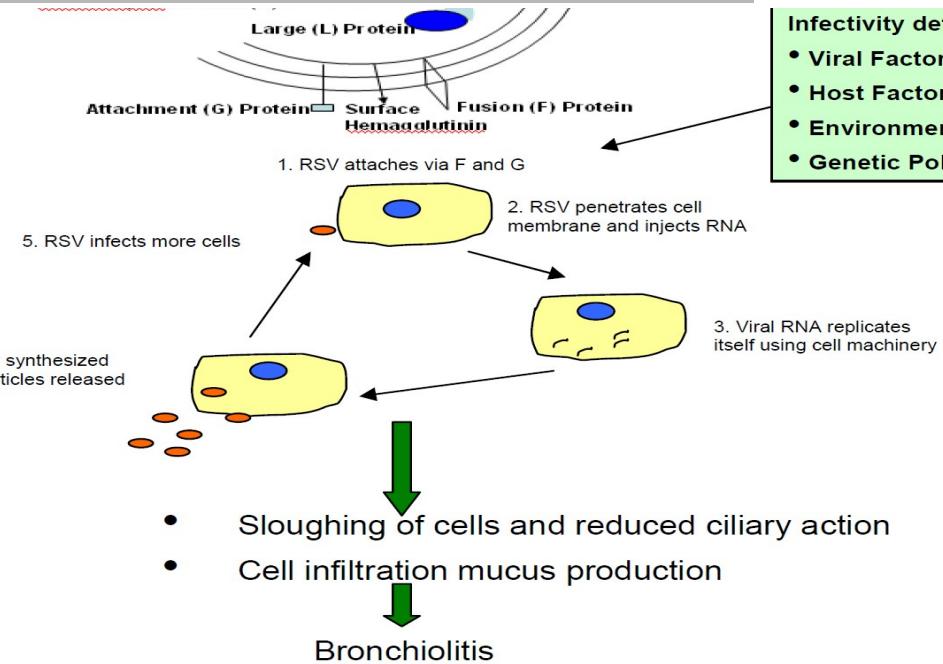
A-The infection is localized to RT (no viremia).

B-The virus attaches to host cells by G protein

Envelope fuses with the host cell membrane by **fusion (F) protein**

F protein causes cells to fuse

Formation of **multinucleated giant cells (syncytia)**.



## 1-Repeated infections are common, Why?

### a-Incomplete (short lived) immunity :

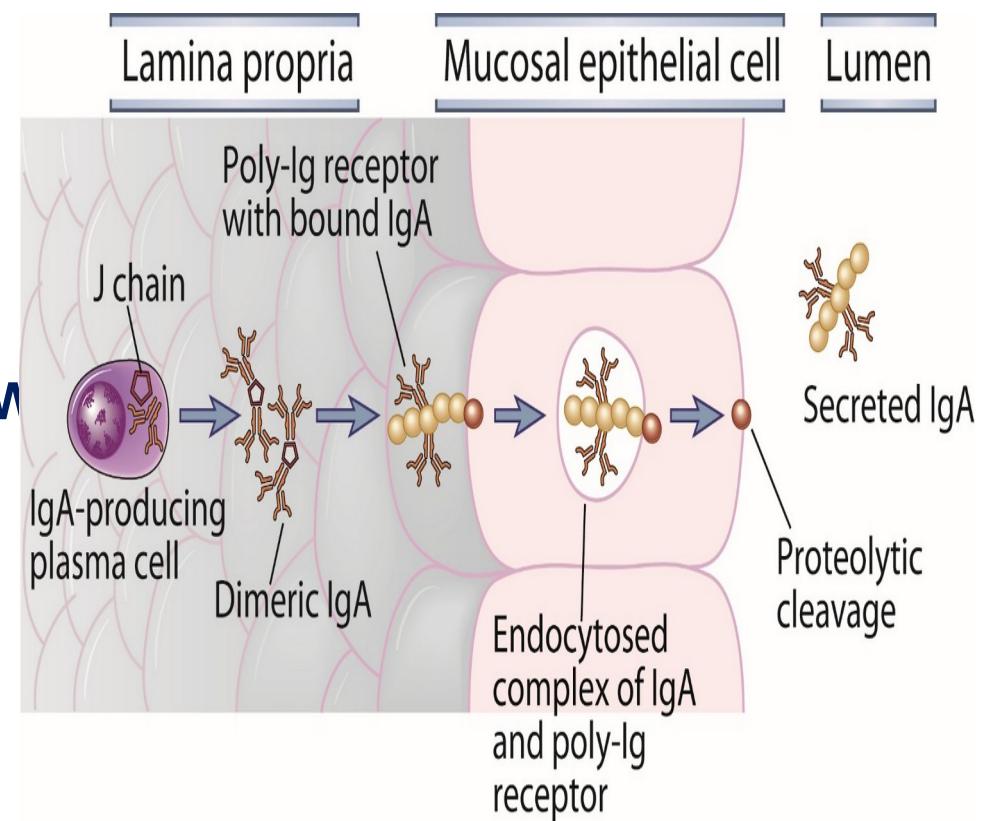
as it is mainly due to **IFN $\alpha$  & secretory IgA**

**b -Antigenic drift** : variation in surface proteins

## 2-Frequency & severity of infection ↓ with aging , Why?

**a-↑ Secretory IgA**

**b- Larger air passages**



# Respiratory syncytial virus (RSV)



## Clinical manifestations

### A- Infants (< 2 yrs)

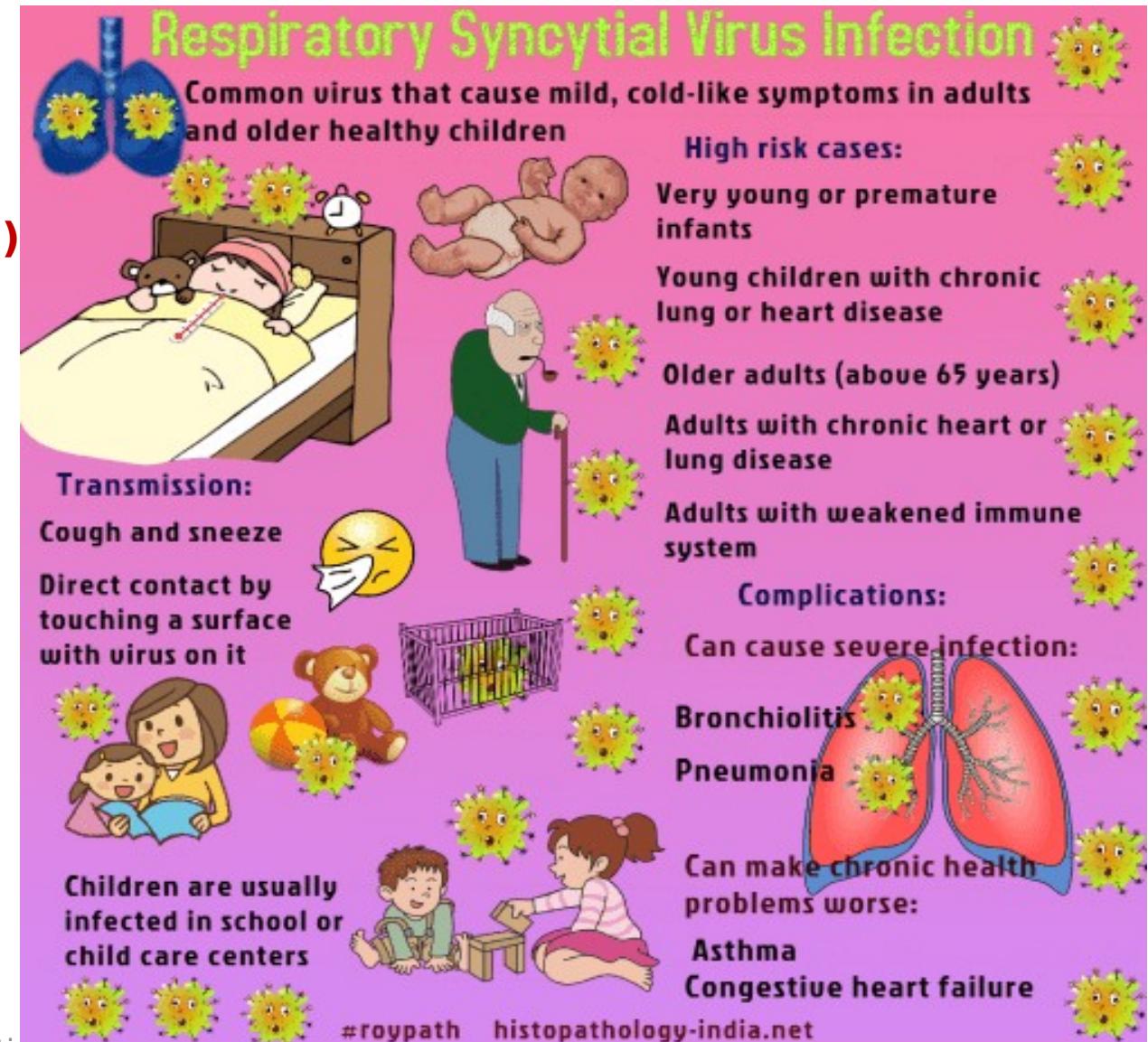
**Bronchiolitis & pneumonia (commonest cause)**

### B- Adults

Common cold & bronchitis

### C - Elderly, adults with heart or lung diseases& immunocompromised patients

**Pneumonia.**



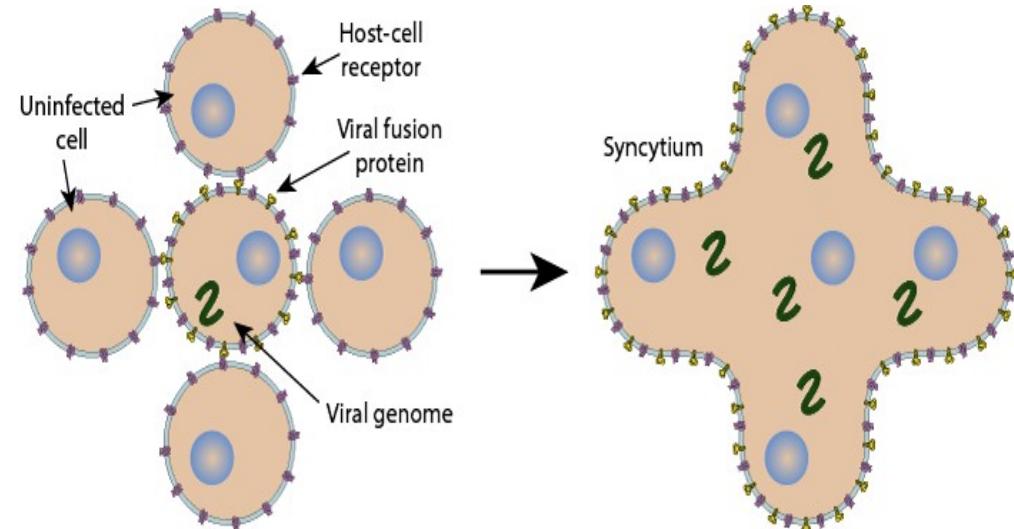
## Laboratory diagnosis

**Specimen** : nasopharyngeal aspirate

### A-Direct virus demonstration :

a.Rapid Ag test : by **DIF** (commonly used)

b.Detection of viral nucleic acid : by **PCR**



### B-Isolation

CPE : **syncitia** formation

### C-Serology :

Detection of **rising titer of IgG**

### Prevention

#### Monoclonal antibody against the RSV F (fusion) protein :

**For premature infants and children with congenital h**

**NB** Can be used also to **treat immunocompromized patient**

9/11/24

infectious module

#### Palivizumab (Synagis®): Mechanism of Action

- Palivizumab is a monoclonal antibody that binds the F (fusion) protein of RSV
- Palivizumab prevents infection of the host cell
- Palivizumab reduces viral replication and spread of RSV to other susceptible cells
- **Protective levels need to be achieved prior to exposure to RSV**





# Lecture Quiz

**Which virus is the leading cause of the croup syndrome in young children?**

- a) Influenza virus
- b) Respiratory syncitial virus
- c) Parainfluenza virus
- d) Adenovirus
- e) Rhinovirus

# SUGGESTED TEXTBOOKS



- ***Review of Medical Microbiology and Immunology, Warren Levinson***
  - from page 683 - 697
  - from page 704 - 707
  - from page 1359 - 1360
  - from page 1363 - 1373



Thank You